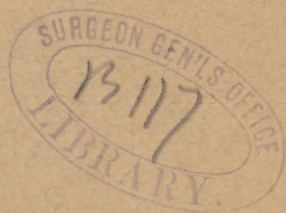


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VALUE OF THE AUDIPHONE.

BY

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## SOME OBSERVATIONS CONCERNING THE VALUE OF THE AUDIPHONE.

By H. KNAPP.

THE extravagant expectations which the fanciful announcements of the "marvelous invention of the audiphone" had awakened in the minds of both physicians and patients, have soon and sadly been disappointed. The principle on which the instrument is based is well known, and numerous examples have long been on record of deaf persons hearing music quite well when putting their head on a piano, or holding one end of a stick between their teeth while the other end rested on the piano. The novelty of the audiphone, dentaphone and similar instruments lies in the application of a solid plate as a sound receiver, the vibrations of which are transmitted to the teeth either directly or, in the manner of a telephone, by means of a string. The sound waves which strike the skeleton parts of the skull can, according to E. H. Weber and all later investigators, be transmitted to the sound-perceiving terminal apparatus of the acoustic nerve, either *directly* through the petrous bone, or *indirectly* through the membrana tympani and the chain of ossicles, or in *both* ways conjointly. The question which was formerly much discussed, viz.: whether sound waves can be transmitted to the expansion of the acoustic nerve in the cochlea directly from the bone, without any participation of the conducting apparatus of the middle ear, has been answered affirmatively by the experiments of

Lucae \* and Politzer.† Politzer states ‡ that there are cases in which loud words are understood by the patient when spoken near his head, but not through a hearing trumpet. I must confess that I have never come across such cases, though I am far from doubting their existence, and have, as everybody, frequently met with patients to whom words spoken in a trumpet were so disagreeable that they preferred not using an instrument at all. Patients of these two classes, and only these, can derive more benefit from the audiphone than from a trumpet. Although my observations with special reference to this point are still limited, I express my opinion without hesitation or reserve that such cases are very rare.

Leaving aside all theoretical considerations, the practical value of the audiphone, dentaphone, and all contrivances that are based on the sound-conduction of the cranial bones, and which Dr. C. H. Thomas of Philadelphia, appropriately calls osteophones, § can be decided by two questions: 1st, does a partially deaf person hear better with an osteophone than when directly spoken to; 2d, does he hear better with an osteophone than with an ear trumpet? According to my experience I have to answer the first question affirmatively, the second negatively.



For a few months I have examined all my private patients that were very hard of hearing, for only such will use instruments, both with a Rhodes' conversation audiphone and a dipper-shaped ear trumpet, (see accompanying figure). The mouth-piece of this trumpet, covered with a perforated

\* *Arch. f. Ohrenhkde*, Bd. I, (1864) p. 308, etc. † *Ibidem*, p. 319, etc.

‡ His *Lehrbuch der Ohrenhkde.*, I, p. 214, (1879).

§ *Philadelphia Med. Times*, February, 1880,

metal plate, has an aperture of 120 *cm.* (4.5"). Its parabolically curved bottom has a diameter of 75 *cm.* The depth is 100 *cm.* The sound-waves reflected from the parabolic bottom are collected in its focus over which the broad curved end of the neck of the instrument expands in such a manner that all the reflected waves are conducted into the patient's ear.

The abstracts of the subjoined fourteen cases will suffice to illustrate the comparative value of the two instruments under different conditions.

CASE I.—Mr. S. S.—, æt. 50. *Otit. med. cat. chron.*<sup>1</sup> —*H*<sup>2</sup> for ten years or more. Pharyngitis, tinnitus, vertigo. Both *Mtt* whitish, sunken. *R* tube open, *L* closed. No improvement of *H* by inflation. *h* = 0, both sides. Pol. acoum. *R* 0, *L* 1". Bone-conduction for low-ticking watch 0, for other instruments good. *V R*  $\frac{1}{6}$  0, *L*  $\frac{2}{6}$  0, (no lip reading). With audiphone, *V* 10'; ear trumpet, *R* 10', *L* 15'.

The conditions of this case are favorable for the use of the audiphone. The patient also heard considerably better with it, yet not so well as with the trumpet, and he stated without being asked that he heard louder and more distinctly with the trumpet than with the audiphone.

1. The disease, in all cases, was on both sides.

2. ABBREVIATIONS:

*H* = acuteness of hearing.

—*H* = diminution of *H*.

*mt* = membrana tympani.

*mtt* = membranæ tympanorum.

*R* = right, or right side.

*L* = left, or left side.

*h* = (horologium) = *H* for watch.

Pol. acoum. = *H* for Politzer's acoumeter.

*V* = *H* for ordinary voice, intelligible at 60'.

*v* = *H* for whispering voice, intelligible at 20'.

*h*  $\frac{1}{2}$  = watch heard on contact with the ear.

*h* 0 = watch not heard on contact with ear.

*V*  $\frac{1}{2}$  = loud voice heard, but not understood, *i. e.* quantitative perception of sound.

*V* 0 =. Voice not heard at all.

Bone-conduction is expressed as follows:

*h*  $\frac{1}{2}$  (mastoid) = watch heard when pressed on mastoid.

*h* 0 (mast.) = watch not heard when pressed on mastoid.

*h*  $\frac{1}{2}$  (temple) or *h* 0 (temple) = watch heard, or not heard when pressed on temple.

*h*  $\frac{1}{2}$  (forehead) or *h* 0 (teeth), etc., are easily understood.

The same: Pol. acoum.  $\frac{1}{2}$  (mast.) or 0 (forehead), and *F*, *i. e.* furca musica, tuning-fork  $\frac{1}{2}$  (forehead), etc., need no special explanation.

I will further state that the tick of my watch is heard at a distance of 24", and Politzer's acoumeter at a distance of about 45" or 15*m.*

CASE 2.—Mr. C. S., æt 30. *Otit. med. cat. chron.* No hereditary tendency to deafness. Tinnitus. Pharyngitis. Tubes strictured. *Mtt* thickened, dull, sunken, handles drawn forcibly backward. On Sige, only a slight motion of handle,  $h R \frac{1}{20}$ , faint;  $L \frac{1}{20}$ . Bone-conduction for watch only on left mastoid. *F* (tuning-fork) by air and bone-conduction from all places of head, well. Pol. acoumeter  $\frac{1}{3}$ " each, well in contact with bone and teeth.  $V R \frac{1\frac{1}{2}}{60}$ ,  $L \frac{1}{60}$ . Audiphone  $1\frac{1}{2}:60$ ; Trumpet,  $R \frac{4}{60}$ ,  $L \frac{6}{60}$ . Speaking-tube a whisper.

In this case the bone-conduction was reduced in about the same proportion as the hearing through air. The advantage of the trumpet over the audiphone was marked.

CASE 3.—Mrs. W. H. M., æt. 63. *Otit. med. cat. chron.* Had erysipelas thirty-seven years ago, producing deafness which disappeared again. Subject to colds. *H* very gradual for thirty years. *Mtt* moderately sunken. Her teeth are very good,  $h=o$ . No bone-conduction for watch. Feels the strokes of Politzer's acoumeter, does not hear its sound.  $V \frac{1}{2}:60$ . With audiphone the same, with parabolic trumpet,  $V \frac{3}{60}$ .

Whether the absence of bone-conduction, common in old age, was the cause of the inefficiency of the audiphone in this case or not, I leave undecided. The examination of numerous cases of this kind may lead to results not without importance.

CASE 4.—Miss C. C., æt. 22. *Chron. aural catarrh.* — *H* 7 yrs. Tinnitus. Posterior wall of pharynx cicatricial. *Mtt* dull, sunken, irregular. Inflation with catheter difficult. No improvement of *H* after Politzer's method.  $h R o$ ,  $L \frac{1}{20}$ ;  $V$  from  $\frac{1\frac{1}{2}}{60}$  to  $\frac{1}{60}$  each. Audiphone, (good teeth)  $V \frac{5}{60}$ ; trumpet,  $\frac{8}{60}$ , each.

Though the bone-conduction in this young patient was perfect, and the physical examination makes the presence of adhesions in the tympanic cavity very probable, the trumpet produced a greater increase of *H* than the audiphone.

CASE 5.—Mr. A. F., æt. 48. *Chron. Otit. med. cat.* — *H*  $2\frac{1}{2}$  yrs. Frequent colds in head. Pharynx cicatricial. Tubes strictured. *Mtt* sunken, handles drawn back and up so that tips are above

horizontal plane. Bone conduction  $R$  absent, on  $L$  side of head good.  $h$   $R$  0,  $L$   $\frac{1}{2}$ ;  $V$   $R$   $\frac{3}{60}$ , improved by Politzer;  $L$   $\frac{1\frac{1}{2}}{60}$ , not improved. Audiphone,  $\frac{1\frac{1}{2}}{60}$ ; trumpet,  $\frac{2}{60}$ .

Though a four weeks' treatment raised  $H$  to  $\frac{2}{60}$  so as to render acoustic appliances for the present unnecessary, I consider this case one of incurable progressive hardness of hearing, requiring trumpets later.

CASE 6.—Miss C. L., æt. 9. Semi-deafmute. *Otit. med. adhes.* Was a very weak child, but not ill. Began to speak only when 5 years old. Body well developed. Teeth good. *Mtt* sunken, uneven, apparently thickened, handles drawn back.  $h$  ?  $V$ .  $\frac{1\frac{1}{2}}{60}$  each. Audiphone,  $1\frac{1}{2}:60$ ; parabolic trumpet,  $R$   $\frac{1}{60}$ ,  $L$   $\frac{6}{60}$ .

It is questionable whether in this case the middle ear disease was complicated or not with a labyrinthine or nervous affection. The young patient derived little benefit from the audiphone, but great benefit from the trumpet, which for the education of speech and the development of what hearing power she had I strongly recommended.

CASE 7.—Miss A. B., æt. 38. *Chron. aur. catarrh.* Deafness in family. — $H$  5 years, gradual. Pharynx pale, dry. *Mtt* sunken. Tinnitus.  $h$  0 and no bone-conduction on either side.  $V$   $R$   $\frac{1}{60}$ ,  $L$   $\frac{2}{60}$ . Audiphone, (teeth artificial, well fitting)  $\frac{5}{60}$ ; trumpet,  $\frac{2}{60}$ .

CASE 8.—Mrs. F. B. C., æt. 29. *Chron. aur. catarrh.* Conditions common.  $h$   $R$  0, no bone-conduction.  $L$   $\frac{1}{2}$ , no bone-conduction for low-ticking watch.  $V$   $R$   $\frac{1\frac{1}{2}}{60}$ ,  $L$   $1\frac{1}{2}:60$ . Audiphone,  $\frac{4}{60}$ ; trumpet,  $\frac{2}{60}$ .

CASE 9.—Miss I. M., æt. 20. *Chr. aur. catarrh.* *Mtt* fairly normal.  $h$   $\frac{1}{2}$  on ear, mastoid and temple, not on forehead.  $V$   $R$   $\frac{4}{60}$ ,  $L$   $\frac{5}{60}$ . Audiphone,  $\frac{5}{60}$ ; trumpet,  $\frac{2}{60}$ .

CASE 10.—Miss J. H., æt. 31. *Chron. aur. catarrh.*  $h$   $\frac{1}{2}$ . Bone-conduction good.  $V$   $\frac{1}{60}$  each. Audiphone,  $\frac{2}{60}$ ; trumpet,  $\frac{4}{60}$ .

CASE 11.—Miss S. B., æt. 10, *Ot. med. pur. chr.* Had symptoms of hereditary syphilis when born, scarlet fever when six weeks old, otorrhœa ever since, keratitis parenchymatosa heredito-syphilitica two years ago; lately a perforating ulcer of hard palate,

and extensive irregular ulcers on soft palate. After several months treatment, condition of pharynx, cornea, ears (which show large defects of *Mt*), and general health materially improved. Tubes pervious. Watch heard on application to ears and teeth, not to cranial bones. Tuning-fork heard by bone-conduction. Pol. acoumeter  $\frac{1}{2}$ " and *VR*  $\frac{4}{60}$ , *L*  $1\frac{1}{2}:60$ . *H* slightly improved by trumpet, not so much by audiphone.

I have mentioned this very complicated case only in order to show that in it neither audiphone nor trumpet had an essential effect on *H*.

CASE 12.—Mrs. E. D. æt. 48. Nervous deafness. —*H* 10 yrs., gradual. No heredity. Ten years ago, after confinement, had chills, and took great quantities of quinine, which always diminished *H*. Pharynx fairly normal; tubes open; *Mt* slightly sunken at centre, white at periphery. *R* *h* =  $\frac{1}{\infty}$ , faint. *L* *h* = 0 (on all places of the head). *R* *h* =  $\frac{1}{\infty}$  (forehead and teeth). *FR* well by air- and bone-conduction, *L* not at all. *VR*  $\frac{1\frac{1}{2}}{60}$ , *L*  $\frac{1\frac{1}{2}}{60}$ . Audiphone,  $1\frac{1}{2}:60$ ; trumpet,  $\frac{8}{60}$ . Through flexible speaking tube she hears a whisper.

The history of this case, the absence of marked changes in the conducting apparatus, the greatly reduced bone-conduction, the very small increase of *H* by the audiphone, and the great increase by trumpets, seems to indicate that the deafness in this case was chiefly produced by an affection of the inner ear and the acoustic nerve.

CASE 13.—Miss M. H., æt. 48. *Otit. med. adhesiva et otit. interna chronica*.. Thirteen years ago, after sleeping near an open window on the sea-shore, became very hard of hearing. Was under skilled treatment; *H* improved at first, then gradually diminished. Pharynx fairly normal; tubes open. *R* *Mt* white, irregularly striped. *L* sclerosis, the bare promontory being felt with probe in centre, fibrous tissue at periphery. No ossicles visible; *h* = 0, each. No bone-conduction for watch on either side. Politzer's acoumeter placed on bone perceived as knocks, not as sound. Tuning-fork only by air-conduction on right side, not from bones. *VL* = 0, *R*  $\frac{1\frac{1}{2}}{60}$ . Speaking tube in *L* not heard, in *R* plainly. Audiphone,  $1\frac{1}{2}:60$ ; dipper trumpet  $\frac{2}{60}$ .

For years marked spells of headache, dizziness, nausea, vomiting, tendency to fall forward. Tinnitus constant, varying in intensity.

In this case of, as it seems, complete deafness on one side, and great hardness of hearing on the other, in both from evident grave disease of the middle ears with implication of the labyrinth and abolition of bone-conduction, the audiphone produced no effect, the trumpet a decided increase of *H*.

CASE 14.—Mrs. G. S. æt. 24. *Otit. med. cat. et interna chronica heredito-syphilitica*. Of this important case, the full report of which I reserve for another occasion, I will here mention only what follows. *HR*  $\frac{1}{2}$ , *L* 0. No bone-conduction. Pol. acoum. *R*  $\frac{1}{2}$ ", *L* 0; on bone everywhere, better on *R* than on *L* side. Tuning-fork *R* only; by bone conduction only from the teeth, well in *R*, scarcely in *L*. *VR*  $\frac{5}{6}$ , *L*  $\frac{1\frac{1}{2}}{6}$ . Flexible tube *R* whisper, *L* strong voice. Audiphone  $\frac{5}{6}$ ; parabolic trumpet *R*  $\frac{1\frac{5}{6}}{6}$ , *L* near by.

In this case no improvement of *H* by the audiphone, but a marked improvement by the trumpet.

In order comprehensively to review the results of the foregoing observations, I have arranged the cases in a table in such manner that *V* (the acuteness of hearing for ordinary voice), determined without the use of an instrument is taken as 1, and *V* determined by the aid of the audiphone and the trumpet is so computed as to represent its proportion to 1. The table therefore shows how many times the audiphone and the trumpet increased the acuteness of hearing of the patients examined.

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## HEARING ACUTENESS FOR LOUD VOICE.

NO.	WITHOUT AN INSTRUMENT.	WITH THE AUDIPHONE.	WITH THE EAR TRUMPET.	DISEASE.
1	1	:	5	Chron. aur. catarrh.
2	1	:	1.5	" "
3	1	:	1	" "
4	1	:	5	" "
5	1	:	5	" "
6	1	:	3	" "
7	1	:	2.5	" "
8	1	:	2.7	" "
9	1	:	1.2	" "
10	1	:	2	" "
11	1	:	1.2	Otit. med. pur. chron.
12	1	:	3	Nervous deafness.
13	1	:	1	{ Chron. inflammation of middle and inner ears.
14	1	:	1	

The table shows that the Rhodes' *audiphone* produced no increase of the acuteness of hearing in 20 per cent. of the cases, a slight increase (from 1.2 to 1.5 times) in 20 per cent., a moderate increase (from 2 to 5 times) in 60 per cent., whereas the *dipper-shaped ear trumpet* produced an increase of the acuteness of hearing in all cases, slight in 8 per cent., moderate (from 2 to 5 times) in 35 per cent., and great (from 6 to 20 times) in 58 per cent. The audiphone, therefore, is not a useless instrument. It increases, in a moderate degree, the hearing power of the majority of very deaf persons; in every case, however, as far as my examinations have gone, was its value exceeded, and in most cases greatly exceeded, by the ear trumpet.

The above cases are not the only ones in which I have tried the audiphone. The general result in all was the same. Other impartial observers have tested the audiphone and found that it falls far short of what its inventor claimed for it. Since the statements of these observers are, as far as I know, expressed only in general terms, I thought that the above quantitative determinations, limited though they be in number, might not be read without interest. Further study of this subject is not without promise, both in a physiological and a practical point of view.





